

# AI-Powered USB Handbook

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USB

*AI-Powered USB Handbook Team*

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# 1. AI-Powered USB Handbook

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AI-Powered USB Handbook			
AI-Powered USB Handbook Type-C	USB	USB 3.2 Gen 2x2	Thunderbolt 4 ( 4)

## 1.1

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- -
- USB - USB
- USB -
- Thunderbolt -
- - USB PD
- -

## 1.2

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- 
- 
- 
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## 2. 1 (Introduction)

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### 2.1

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USB (Universal Serial Bus) Type-C			USB	USB 3.2 Gen 2x2
AI-Powered USB Handbook	USB	AI		

### 2.2

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	4	USB4		
		USB		

### 2.3

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1.
2. USB 1.0 USB4
3. Intel Thunderbolt USB
4. USB PD PPS
5.

## 3. 2 USB (USB Connector Types)

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USB

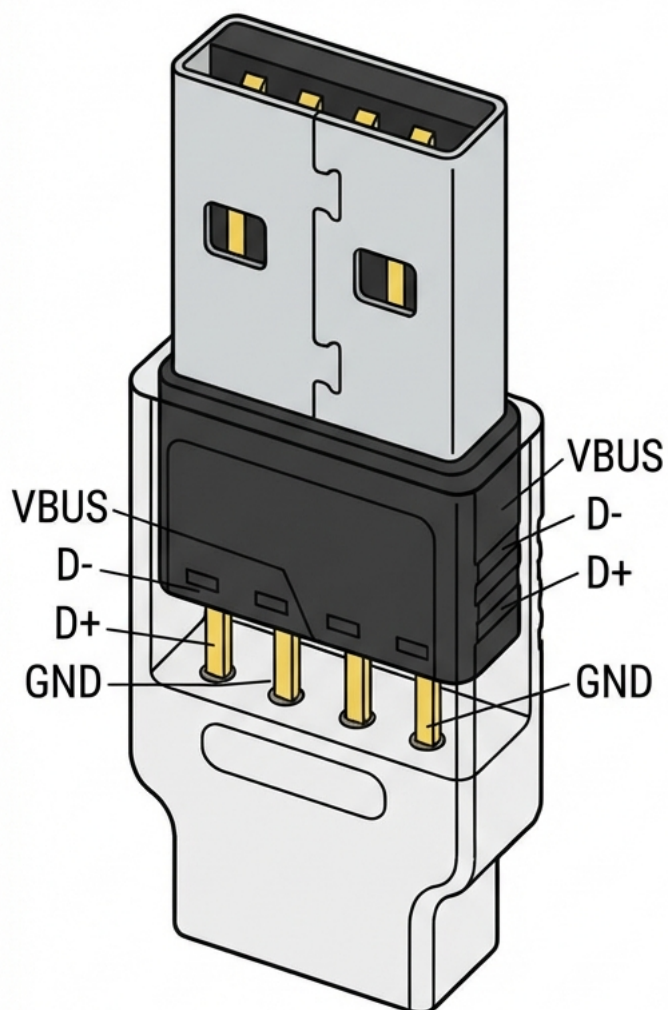
### 3.1 USB Type-A

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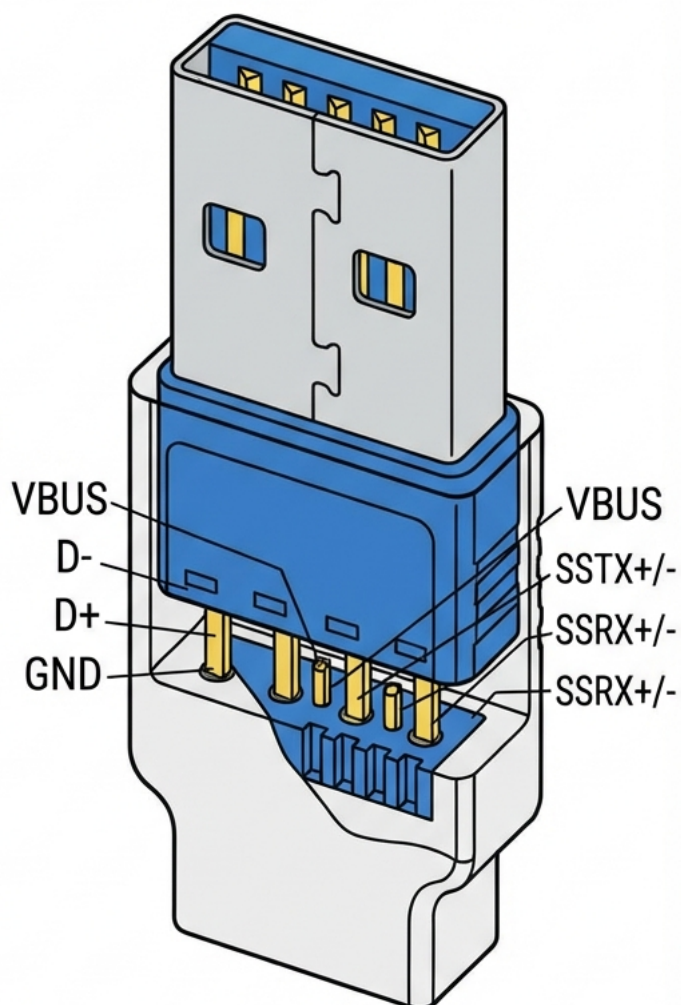
USB

- 
- 
- **USB 2.0** 4
- **USB 3.0+** 5 9

USB 2.0 Type-A



USB 2.0 Type-A

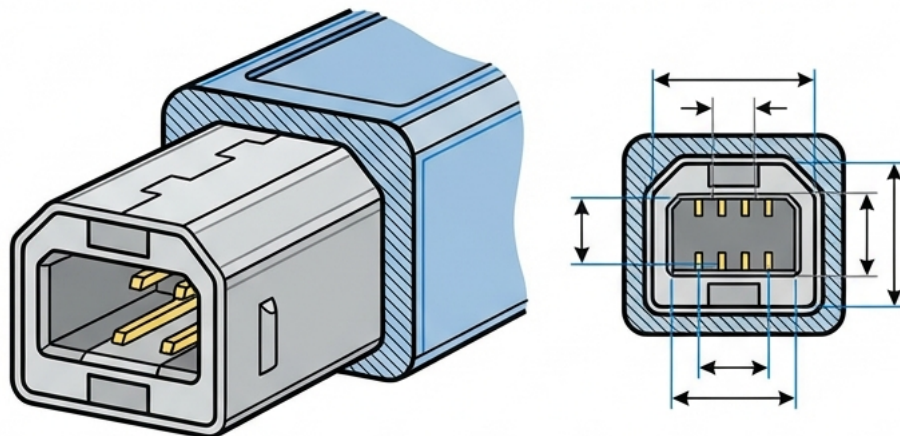
USB 3.0 Type-A  
(SuperSpeed)USB 3.0 Type-A  
(SuperSpeed)

### 3.2 USB Type-B

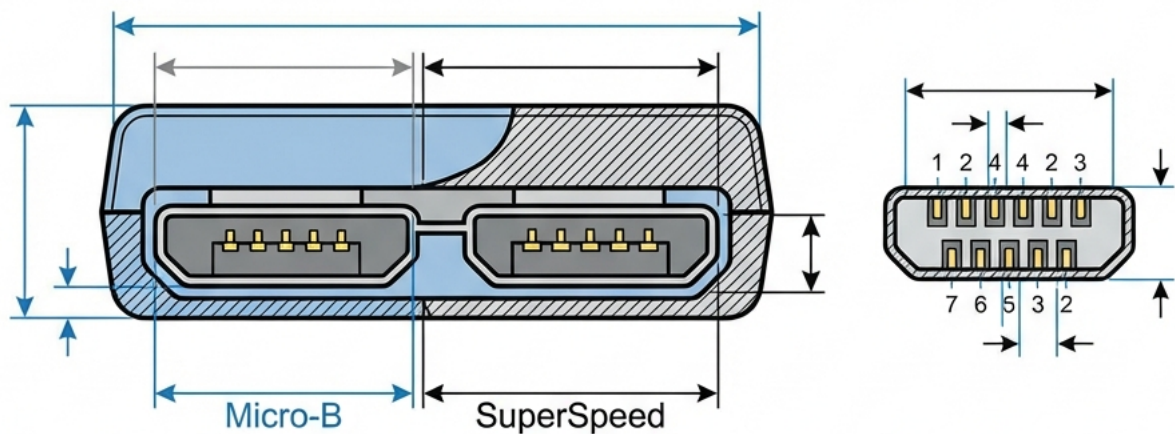
- Standard-B
- Micro-B (USB 3.0)

Elements

USB 3.0



USB Standard-B  
(Printer)



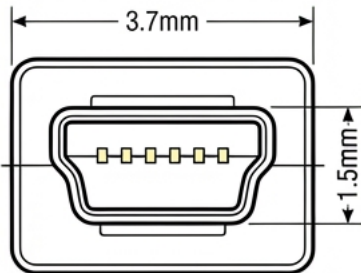
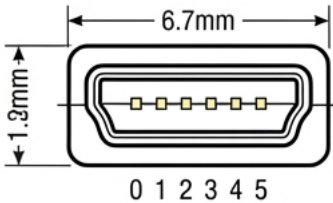
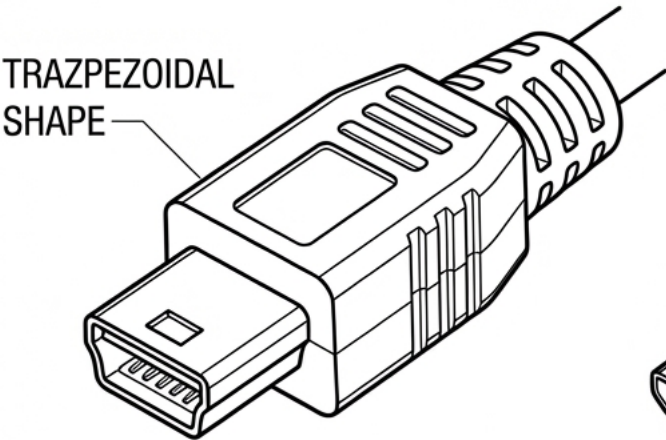
USB Micro-B SuperSpeed  
(External HDD)

### 3.3 Mini USB & Micro USB

- **Mini USB** MP3
- **Micro USB**

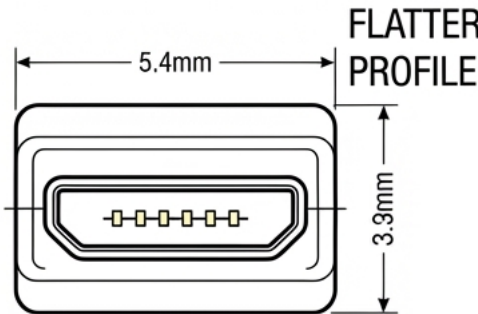
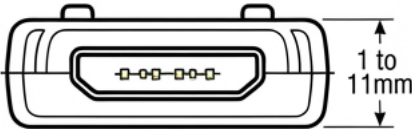
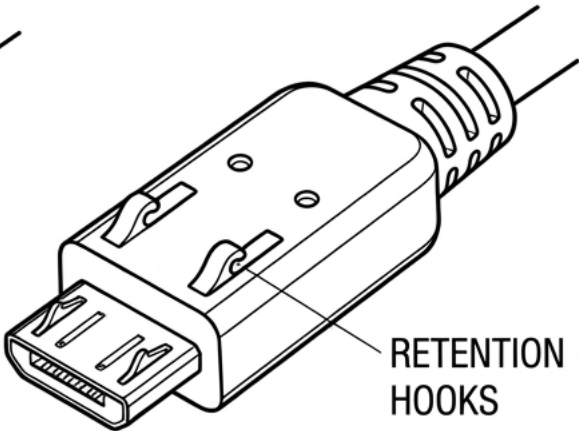
USB 2.0

# MINI USB



# MINI USB

# MICRO USB

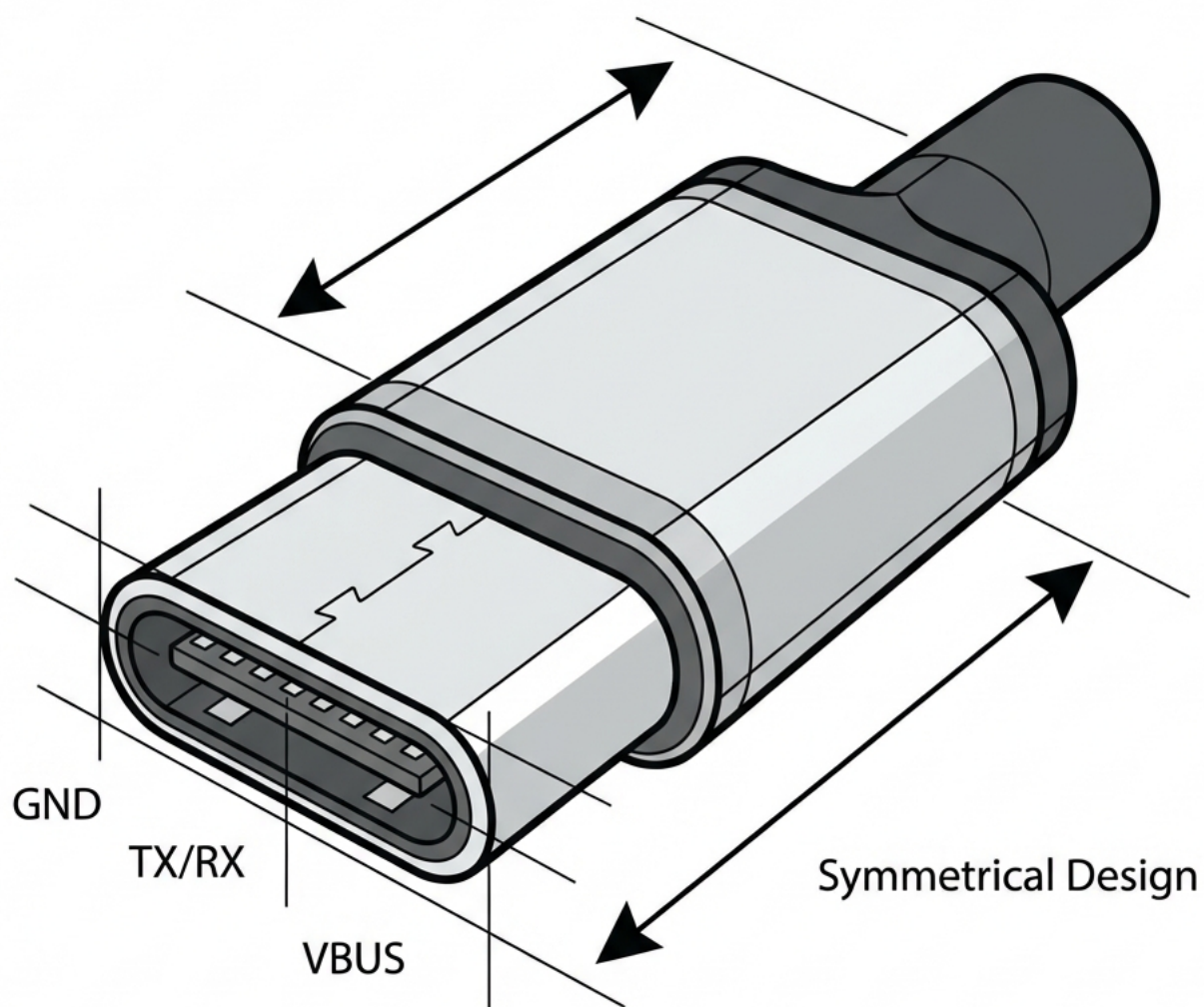


# MICRO USB

3.4 USB Type-C

•				
•				
•		DP Alt Mode	240W	USB PD
•	24	22	CC (Configuration Channel)	
•	Type-C	Type-C	USB 2.0	4





## 4. 3 USB (USB Transfer Protocols)

USB USB-IF (USB )

### 4.1

- **USB 1.0 / 1.1:**
- **Low Speed:** 1.5 Mbps ( )
- **Full Speed:** 12 Mbps
- **USB 2.0:**
- **High Speed:** 480 Mbps “ ”

### 4.2 USB 3.x

	(2013)	(2019)			
USB 3.0	USB 3.1 Gen 1	USB 3.2 Gen 1	USB 3.0 / 5Gbps	5 Gbps	8b/10b
N/A	USB 3.1 Gen 2	USB 3.2 Gen 2	USB 3.1 / 10Gbps	10 Gbps	128b/132b
N/A	N/A	USB 3.2 Gen 2x2	USB 3.2 / 20Gbps	20 Gbps	128b/132b

USB 3.2 Gen 2x2 Type-C Type-C

### 4.3 USB4

USB4 Intel Thunderbolt 3

- **USB4 Gen 2x2:** 20 Gbps
- **USB4 Gen 3x2:** 40 Gbps ( )
- 
- **(Tunneling)** (USB 3.2) (DisplayPort) PCIe
- USB 3.2 USB 2.0 Thunderbolt 3

## 5. 4 Thunderbolt ( ) (Thunderbolt Technology)

Thunderbolt Intel Apple “ ” “ ”

### 5.1 Thunderbolt 3 ( 3)

- USB Type-C
- 40 Gbps
- PCIe x4 ( ) DisplayPort ( 5K/8K ) USB
- 3 USB 3.x USB

### 5.2 Thunderbolt 4 ( 4)

4 40 Gbps

#### 5.2.1 4 vs 3

- |                |   |                |                    |          |               |     |
|----------------|---|----------------|--------------------|----------|---------------|-----|
| 1. <b>PCIe</b> | 4 | PCIe           | <b>32 Gbps</b> ( 3 | 16 Gbps) | (eGPU)        | SSD |
| 2.             | 4 | <b>4K</b>      | <b>8K</b>          | ( 3      | 4K)           |     |
| 3.             |   | Intel VT-d DMA | DMA                |          |               |     |
| 4.             | 4 | <b>(Hub)</b>   | 1 3                | 3        | (Daisy Chain) |     |

### 5.3 Thunderbolt vs USB4

- USB4 3
- 
- **USB4** “ ” 20Gbps 40Gbps PCIe
- **Thunderbolt 4** “ ” 40Gbps PCIe Intel
- **Thunderbolt 4** **USB4** “ ”

6. 5 (Charging & Power Delivery)

USB	2.5W (5V 0.5A)	240W
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6.1

• USB BC 1.2 (Battery Charging)	7.5W (5V 1.5A)
• QC (Quick Charge) OPPO VOOC SCP/FCP	

6.2 USB PD (Power Delivery)

USB PD	USB-IF	Type-C
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6.2.1

• PD 2.0 / 3.0:	100W (20V 5A)
• 5V, 9V, 15V, 20V	
• PD 3.1:	EPR (Extended Power Range) 240W
• 28V, 36V, 48V	

6.2.2 PPS (Programmable Power Supply)

PPS	PD 3.0	20mV	-	-	“ ”	PPS
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6.3 (E-Marker )

Type-C	
• 3A	C-to-C 60W (20V 3A)
• 5A	E-Marker “ 5A ” 100W (20V 5A)
• EPR	PD 3.1 240W

7. 6

(FAQ & Common Misconceptions)

7.1 Q:

Type-C

A:

1.

VOOC

10W

USB 2.0

3.

E-Marker

3A

65W/100W

2.

PD

7.2 Q:

Type-C

A:

Type-C

C

-9.9

+ USB 2.0

-

USB 3.2 (10Gbps) + 4K

+ 100W

-

4

40Gbps

+ 8K

+ 240W

Logo

7.3 Q:

65W

A:

USB PD

"

"

"

9V 2A

"

18W

PD

5V 1A

5V 2A

7.4 Q:

A:

-

5A

4

-

USB 3.2